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Performance of the Beef Cow-Calf Sector

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ABSTRACT

Available data indicate general improvement in the technical efficiency of production of the U.S. beef cow-calf sector since 1975. By contrast, indicators of economic performance suggest that the overall volume of resources allocated to cow-calf production remains inefficiently large and that recent adjustments in regional and enterprise-size characteristics of the sector have been inadequate to achieve available improvements in economic efficiency.

Key words: Beef cattle, cow-calf production, performance, technical efficiency, economic performance, resource allocation.

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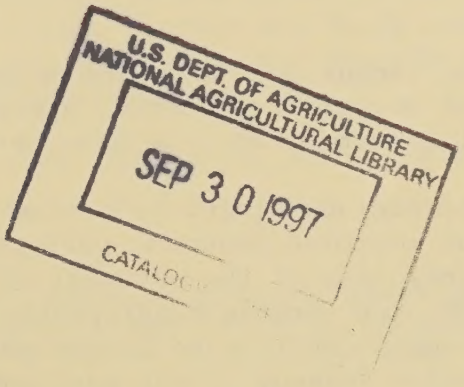

SUMMARY

Most measures of technical efficiency for which data are available indicate an improvement in physical performance of the U.S. beef cow-calf sector since the midseventies. The average number of calves born annually per 100 beef cows and breeding-age heifers in the national inventory increased from 79 in 1975 to 87 in 1980, based on sequential surveys of producers with herds of 20 or more brood cows each. A small increase in the use of artificial insemination in beef cow-calf production contributed to an increase in the cow-to-bull ratio from 22.4 in 1975 to 24.9 in 1980.

Average weight per head of feeder cattle sold or placed on feed by cow-calf producers increased by amounts ranging from 11 pounds per head for heifer calves to 32 pounds for yearling steers. Total weight sold (or transferred to feedlots operated by cow-calf producers) per cow in inventory was 7.6 percent greater in 1980, reflecting improvements in both growth rates and death loss rates for all classes of feeder cattle.

In all regions except the West, cow-calf producers used smaller acreages of privately owned grazing land per cow in 1980 than in 1975, although lower stocking rates in the West caused an increase in the national average use per cow of rangeland. An average reduction of 9 percent in the use of harvested forages per hundredweight of cattle transferred from the cow-calf sector in 1980 compared with 1975 was only partially offset by increased use of concentrate feeds in 1980.

Labor efficiency is the only measure of physical productivity included in this analysis that was less favorable in 1980 than 1975. Estimated total labor use per cow was 11 percent greater on average in 1980 than in 1975, because of an increase in the quantity per cow of unpaid labor reported by producers with enterprises of fewer than 100 cows each. Estimated average use per cow of hired labor, by contrast, declined by about 20 percent during this period.

Indicators of recent economic performance of the cow-calf sector paint a totally different picture. Annual estimates of average sales receipts and production costs per cow indicate that net returns to operator management and risk have been increasingly negative each year since 1979. In 1977, 1982, and 1983, cattle sales receipts failed to cover even cash expenses in the average cow-calf enterprise.

Furthermore, census data indicate no appreciable change since 1974 in the distribution of cow-calf production operations by size of enterprise, although substantial economies of size have persisted in the sector for at least 6 years.

A small interregional shift in production since 1974 is the only available indicator of improved economic performance. The South maintained about 2 percentage points less of the national inventory of beef cows in 1982 than in 1974. In the South, net returns consistently have been lower. However, marginal production costs continue to exceed product prices in each regional and enterprise-size segment of the beef cow-calf production sector.

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INTRODUCTION

Beef cow-calf production in the United States has undergone unprecedented changes since 1975. The January 1 national inventory of beef cows declined by 19 percent between 1975 and 1979. This represents the longest consecutive period of decline and by far the greatest total reduction in beef cow numbers in recent history (fig. 1). Since 1979, producers have alternately increased and curtailed beef cow numbers by relatively small increments, in contrast to the long periods of sustained expansion that followed the low points in each of the previous inventory cycles. This report assesses the performance of the cow-calf sector during this unusual period of adjustment.

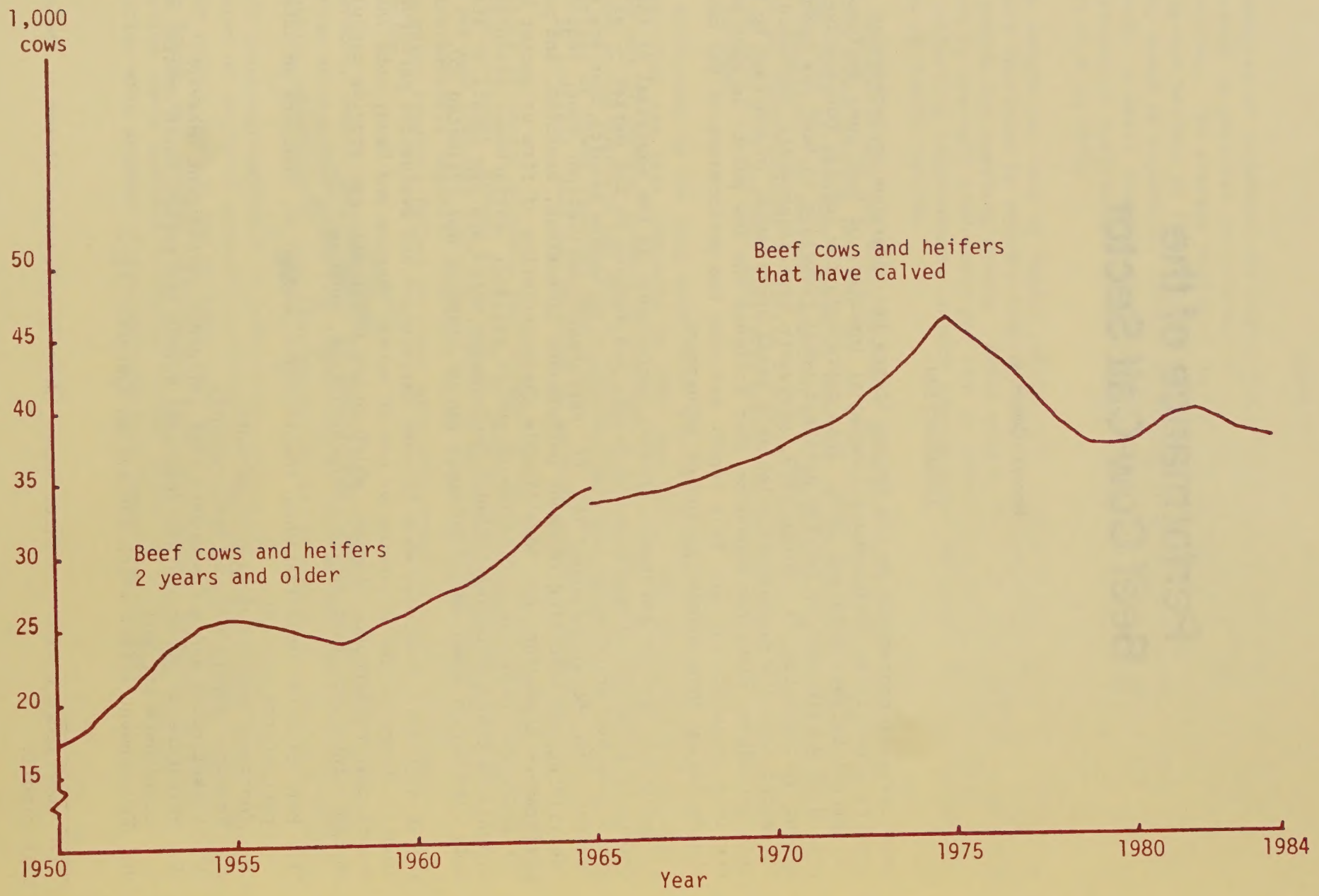
As defined by Marion and Handy, "Market performance is the appraisal of the extent to which the interactions of buyers and sellers in the market -- as influenced by market rules and institutions -- stimulate results that are consistent with social purposes" (5). 1/ Performance evaluation, thus, requires identifying and selecting relevant performance dimensions, measures, and norms. Performance dimensions are identifiable characteristics of firm or sector behavior which are important indicators of public welfare. Performance measures are dimensions that can be quantified. Performance norms are the ideals or standards with which observed performance can be compared and evaluated (5).

A distinction is sometimes made between descriptive and evaluative performance studies, based on the existence or use of norms. Marion and Handy note that descriptive performance studies, which do not use norms, may provide useful insights into important sector characteristics, such as:

"1. Participants: organizations, institutions, and so on, that are an integral part of the system;
2. Functions performed by participants;
3. Resource inputs used by participants;
4. Market rules and arrangements that influence participant behavior;
5. Structure of authority and decisions within the system which control and coordinate it; and
6. Environment within which the system operates" (5).

1/ Underlined numbers in parentheses identify references listed at the end of this report.

Figure 1. Number of beef cows in the United States, January 1



Sources: (10, 15).

A recent ERS publication included a detailed description of the U.S. beef cow-calf sector in 1980 (2). Petritz, Erickson, and Armstrong provide more comprehensive, though less current, description of the entire cattle and beef industry (6).

This report focuses on evaluative performance of the cow-calf sector. Performance measures of the entire sector and of selected components of the sector in 1975 represent the principal norms used to evaluate more recent performance and to project future adjustments. Developments in the cattle feeding and beef marketing sectors and the hog-pork and poultry industries are also used as comparisons.

The beef cow-calf sector, as used in this report, includes all cattle-breeding enterprises operated primarily for the production and sale of young cattle that are subsequently grown out and/or fattened to slaughter weights, usually in the cattle feedlot sector. This broad definition includes firms that sell part or all of the progeny of their cow herds at 1 year or older (sometimes called cow-yearling operations) in addition to the more narrowly defined cow-calf enterprises in which all young animals not retained as breeding stock are sold as calves (younger than 1 year old).

PRODUCTIVITY MEASURES

Because of the great variety in type and quality of inputs used and of cattle produced in the beef cow-calf sector, no single measure of physical or technical productivity can adequately assess sector performance. Several productivity ratios that can be derived from available data do, however, provide measures of various aspects of overall productivity and technical performance.

Reproductive Efficiency

Production of young cattle for sale as feeder animals is the primary objective in the cow-calf sector. The calving rate, or number of calves born each year per unit of breeding stock, is thus a measure of the initial success in the production effort.

No direct estimates of annual calving rates in the beef cow-calf sector are available on a regular basis. Statistical Reporting Service (SRS), U.S. Department of Agriculture (USDA), data can be used, however, to estimate proxies. SRS data include January 1 and July 1 inventories of: (1) beef cows that have calved, (2) milk cows that have calved, (3) heifers weighing 500 pounds or more, kept as replacements for (or net additions to inventories of) beef cows, (4) heifers kept as milk cow replacements (or additions), (5) all bulls weighing 500 pounds or more, and (6) estimates of the total calf crop (from beef and milk cows combined) during each calendar year.

A proxy for the actual calving rate is frequently estimated by dividing the annual calf crop by the January 1 inventory of beef plus milk cows. This ratio obviously applies to all cow herds rather than to the beef cow-calf sector specifically. It also overestimates the actual calving rate, because heifers bred to calves during the calendar year are not included in the denominator. During the last 10 years, the ratio has ranged from 0.86 calf born per cow in the January 1 inventory in 1976 to a high of 0.94 calf per cow in 1980 (table 1).

Table 1 -- Ratio of calves born to January 1 cow inventories, 1975-84

Year	January 1 Beef cows	January 1 Milk cows	January 1 All cows	Calves born	Calving ratio 1/
	1,000 head				Ratio
1975	45,712	11,220	56,931	50,183	0.88
1976	43,901	11,071	54,971	47,384	.86
1977	41,443	10,998	52,441	45,931	.88
1978	38,738	10,896	49,636	43,818	.88
1979	37,062	10,790	47,852	42,603	.89
1980	37,086	10,779	47,865	44,998	.94
1981	38,726	10,860	49,586	44,776	.90
1982	39,319	11,012	50,331	44,420	.88
1983	38,079	11,076	49,154	44,093	.90
1984	37,660	11,140	48,800	43,400	.89

1/ Calves born divided by all cows in inventory, January 1.

Sources: (10, 13, 15).

The Western Livestock Marketing Information Project (WLMIP) computes a more conservative combined (beef plus milk cow) calving rate proxy. WLMIP divides the number of calves born annually by the sum of January 1 beef and milk cow inventories plus an estimate of the number of heifers that calve during the year and converts the result to a percentage term (table 2). This estimation procedure approximates the actual calving rate to the extent that: (1) the January 1 cow inventory includes all, and only, cows bred (exposed to a bull or artificially inseminated) to calve during the calendar year, and (2) all heifers bred to calve during the year actually have a calf and enter the cow herd. The WLMIP estimates indicate the same calving rate pattern as the proxy based only on January 1 cow inventories. The overall calving rate rose from 1975 to 1980 and has declined slightly since then.

Both proxy measures are generally consistent with direct estimates of the calving rate in the beef cow-calf sector in 1975 and 1980 derived from 1976 and 1981 ERS surveys (1, 2). In each of these surveys, producers with herds of 20 or more beef cows reported numbers of beef cows and breeding age heifers exposed to a bull or artificially inseminated to calve during 1975 and 1980, respectively. They also reported numbers of calves born alive during each of these years. These data indicate that the national average beef cow-calf calving rate was one-tenth higher in 1980 than in 1975 (table 3).

This increase is partially attributable to the change in the proportion of beef replacement heifers compared with beef cows that were bred to calve in 1975 versus 1980. The calving rate among heifers is normally lower than for mature cows. Since the gestation period for cattle is approximately 9 months, heifers that were bred to calve in 1975 should have been included as heifers weighing 500 pounds or more in the January 1 inventories of 1974 and/or 1975. Replacement heifers accounted for about 16 percent of total potential female beef

breeding stock at the beginning of 1974 and 1975, compared with just over 13 percent of the total in 1979 and 1980 (table 4). Since 1980, heifers have averaged about 14 percent of the total breeding inventory. This is close to the minimum proportion of heifers needed to maintain a stable breeding inventory under current production technology.

Table 2 -- Estimated percentage calf crop, 1975-84

Year	Total cows Jan. 1 1/	Heifers that calve during year 2/	Total	Calf crop 1/	Calf crop as percentage of total
	1,000 head				Percent
1975	56,931	10,443	67,374	50,183	74.5
1976	54,971	8,917	63,888	47,384	74.2
1977	52,441	7,853	60,294	45,931	76.2
1978	49,635	7,433	57,068	43,818	76.8
1979	47,852	6,662	54,514	42,603	78.2
1980	47,866	8,807	56,673	44,938	79.3
1981	49,622	7,982	57,604	44,666	77.5
1982	50,216	6,877	57,093	44,200	77.4
1983	48,986	7,948	56,934	43,925	77.2
1984	48,603	6,953	55,556	42,499	76.5

1/ SRS estimate.

2/ From table entitled Heifers Entering Cow Herd (WLMIP estimates).

Source: (23).

Table 3 -- Average calving rates in the beef cow-calf sector, by region, 1975 and 1980 1/ 2/

Year	South	North Central	Great Plains	West	All regions
			Percent		
1975	73	81	80	78	79
1980	84	87	89	87	87

1/ Number of live calves born per 100 cows and heifers exposed to a bull or artificially inseminated to produce a calf in cow-calf herds of 20 or more cows during the specified calendar year.

2/ Regions designated for the 1981 survey. The 1975 Great Plains calving rate shown here is the weighted average of data for regions termed the Great Plains and the Southwest in the 1976 survey.

Sources: (1, 2).

Improvement in the control of brucellosis, a disease that may cause embryonic mortality and other breeding problems, also contributed to the calving rate increase between 1975 and 1980, particularly in the South and southern Great Plains. Brucellosis remains a serious problem in these areas, however, and intensified control efforts are ongoing or planned in a number of States. For example, North Carolina and South Carolina attained a brucellosis-free status during the summer of 1984 by having no detected incidence of the disease in the preceding 12 months. Further improvements in the calving rate may be expected as eradication or control measures in other States succeed.

The calving rate, as defined above, measures live calf births per sexually mature female in the breeding herd; it does not necessarily reflect efficiency in the use of male breeding stock. Although a few calves are deliberately fed to normal slaughter weights as intact bulls, most that are not intended for breeding are castrated (or sold for veal) at relatively young ages and light weights. Thus, most bulls in inventory weighing 500 pounds or more are actual or prospective herd sires. The ratio of cows plus replacement heifers to bulls of 500 pounds or more in inventory is thus a proxy for the cow-to-bull ratio in cattle (beef plus dairy) breeding herds.

During the last 10 years, the ratio of cows plus replacement heifers to bulls in the January 1 inventory has fluctuated very little, ranging from 23 in 1983 to 23.8 in 1979 (table 5). These data suggest no recent trend in intensity of herd bull use in cattle breeding.

Table 4 -- Beef replacement heifers as a percentage of beef cows and heifers in inventory, January 1, 1974-84

Year	Beef cows	Heifers 500 lb and over, kept as beef cow replacements	Total, beef cows and replacement heifers	Heifers as a percentage of total
	- - - - - - - - 1,000 head - - - - - - - -			Percent
1974	43,182	8,193	51,375	15.9
1975	45,712	8,884	54,596	16.3
1976	43,901	7,192	51,093	14.1
1977	41,443	6,527	47,970	13.6
1978	38,738	5,858	44,596	13.1
1979	37,062	5,527	42,589	13.0
1980	37,086	5,939	43,025	13.8
1981	38,726	6,136	44,862	13.7
1982	39,319	6,615	45,934	14.4
1983	38,079	6,343	44,422	14.3
1984	37,660	6,195	43,855	14.1

Sources: (10, 15).

Table 5 -- Cows and replacement heifers per bull in inventory, January 1, 1974-84

Year	Cows that have calved	Replacement heifers 500 lbs and over	Total cows plus heifers	Bulls 500 lbs and over	Cow-to-bull ratio
	1,000 head				Number
1975	56,931	12,971	69,902	2,985	23.4
1976	54,971	11,148	66,119	2,845	23.2
1977	52,441	10,414	62,855	2,664	23.6
1978	49,636	9,744	59,380	2,538	23.4
1979	47,852	9,459	57,311	2,403	23.8
1980	47,865	10,097	57,962	2,492	23.3
1981	49,586	10,481	60,067	2,547	23.6
1982	50,331	11,147	61,478	2,618	23.5
1983	49,154	10,876	60,030	2,615	23.0
1984	48,800	10,736	59,536	2,550	23.3

Sources: (10, 15).

Available information concerning the cow-to-bull ratio in the beef cow-calf sector suggests a different conclusion. Census of Agriculture data indicate that farms with herds of fewer than 20 cows each were a larger proportion (about 7 percentage points more) of all beef farms, and included about 2 percent more of the national beef cow herd in 1982 than in 1974. To the extent that herd bulls were kept in the same proportion of these very small herds in 1982 as in 1974, the cow-to-bull ratio in the sector as a whole would tend to be slightly lower in 1982. In contrast, data from the ERS surveys of 1976 and 1981 indicate that the average cow-to-bull ratio in herds of 20 or more beef cows (which include more than 85 percent of the national beef cow inventory) increased from 22.4 in 1975 to 24.9 in 1980 (table 6). This amounts to almost 1 less herd bull for each 200 beef cows and replacement heifers in 1980 than in 1975. These data indicate that the number of calves born per 100 head of breeding stock (male plus female) in the beef cow-calf sector increased from 75 in 1975 to 84 in 1980, a 12-percent increase, compared with a 10-percent increase based on female breeding stock only (table 3).

An increase between 1975 and 1980 in the average cow-to-bull ratio in the beef cow-calf sector is consistent with other information obtained in the ERS surveys. For example, 3 percent of all producers surveyed used artificial insemination (AI) on at least part of their cows in 1980, compared with almost no reported use of AI in 1975 (2). One reason for the slow past rate of adoption of AI by beef cow-calf producers has been the large amount of labor needed to identify and corral individual cows in heat in a pasture or range environment. Use of recently approved hormonal materials that can be injected to synchronize estrus in beef cows and heifers could greatly reduce this labor requirement by permitting successful insemination of most of an entire herd during a single

Table 6 -- Cow-to-bull ratio in the beef cow-calf sector, 1975 and 1980 1/ 2/

Year	South	North Central	Great Plains	West	All regions
			Number		
1975	25.9	24.2	21.9	20.5	22.4
1980	26.7	28.0	24.3	22.2	24.9

1/ Number of beef cows plus replacement heifers per bull in cow-calf herds of 20 or more cows during the specified calendar year.

2/ Regions designated for the 1981 survey. The 1975 Great Plains ratio shown here is the weighted average of data for regions termed the Great Plains and the Southwest in the 1976 survey.

Sources: (1, 2).

day. This technology in combination with more aggressive efforts by AI purveyors to identify, acquire semen from, and publicize superior bulls of all major beef breeds will probably make AI an increasingly attractive alternative for cow-calf producers.

Recent improvements in reproductive efficiency in the beef cow-calf sector have been matched by hog producers whose pork is highly competitive with retail beef. SRS data indicate that the average number of pigs weaned per litter changed little during the last 10 years, fluctuating between 7.1 and 7.4 live pigs per litter (10, 14). Annual production of pigs per head of breeding stock in inventory on December 1 (of the preceding year) and June 1 (of the current year) did apparently increase, however, by about 15 percent (table 7). This suggests that each sow and replacement gilt in the breeding herd was bred to farrow less frequently, on average, in 1975 than in recent years. Analysis of ERS survey data appears to support this conclusion. In more intensive (usually larger) hog enterprises, sows are normally rebred within a few days after their previous litters are weaned, and the average weaning age reported by survey respondents decreased by about 11 percent, from 6.2 weeks in 1975 to 5.5 weeks in 1980 (17, 19).

Producers with the largest operations (those who sold 5,000 or more hogs and pigs annually) averaged eight pigs per litter weaned at an average age of less than 4 weeks in 1980. Assuming normal success in getting their sows to rebreed (and their replacement gilts to breed) on schedule, these producers weaned 15 or more pigs per sow and gilt in the breeding herd, around 50 percent more than the average of all producers. The potential for improvements in reproductive performance is thus considerably greater in hog production than in the beef cow-calf sector, given current production technology.

Table 7 -- Average annual pig crop per head of breeding stock in inventory, 1975-84

Year	Breeding stock 1/	Pig crop	Pigs per head of breeding stock
	1,000 head		Number
1975	7,373.5	71,186	9.7
1976	7,981.0	84,395	10.6
1977	8,349.5	86,162	10.3
1978	8,730.5	88,512	10.1
1979	9,986.5	102,691	10.3
1980	9,568.0	101,542	10.6
1981	8,753.0	93,776	10.7
1982	7,616.0	84,022	11.0
1983	7,744.5	92,244	11.9
1984	7,343.5	82,978	11.3

1/ Average of breeding stock inventories on December 1 of preceding year and June 1 of specified year.

Sources: (10, 14).

Rate of Gain

Calf weaning weight is widely used to evaluate the productivity of those beef cattle-raising enterprises that primarily sell breeding stock. Many States have beef cattle improvement programs promoted by the Agricultural Extension Service and/or the cattlemen's association. These programs focus on weaning weight, defined as actual calf weight adjusted to a standard age of 205 days, and further adjusted to compensate for calf sex and age of dam. However, most commercial cow-calf producers do not participate in such formalized evaluation programs, and weaning weight data are not generally available. The only stage of development for which most producers have accurate knowledge of calf weights is time of sale, which may occur at average calf ages ranging from less than 6 months to more than 18 months old.

ERS survey respondents reported numbers and average weights of feeder cattle sold in 1975 and 1980, respectively, by age class (calves or yearlings) and sex. Average sale weight was higher for each class of feeder cattle in 1980 than in 1975. Increases ranged from 11 pounds per head (2.6 percent) for heifer calves to 32 pounds (5 percent) for yearling steers (table 8). Although these data suggest an improvement in average rate of gain between 1975 and 1980, they do not provide unequivocal evidence, because average age at time of sale for each class is unknown for either year. However, the fact that the average weight of cull cows sold in 1980 was 18 pounds greater than in 1975 appears to lend added support to the probability that feeder cattle did gain faster in 1980, but at a cost. Additional feed and other resources were probably required to maintain brood cows that were about 2 percent larger on average.

Table 8 -- Average weight per head of feeder cattle sold, by sex and age class, 1975 and 1980

Year	Steers		Heifers	
	Calves	Yearlings	Calves	Yearlings
	Pounds			
1975	427	630	415	593
1980	444	662	426	610

Sources: (1, 2).

The relative proportions of calves and yearlings produced in the sector, hence the class and weight composition of the principal product of the sector, vary with perceived or anticipated changes in agronomic and economic conditions. Retaining of calves for use as breeding-herd replacement animals reduces the market supply of feeder cattle, while cull breeding stock represents an offsetting secondary joint market product. The relative proportions of feeder cattle and cull breeding stock supplied vary with breeding herd replacement (and expansion or contraction) rates. These rates are related to structural characteristics of firms in the sector and to economic conditions confronting the sector. Thus, there is no single, standardized measure of the product of the cow-calf sector.

Average total weight of cattle transferred (sold or placed on feed by cow-calf producers) from the cow-calf sector per cow or replacement heifer exposed to natural or artificial insemination is perhaps a better measure of productivity than sale weight per animal. Average weight transferred per cow was 32 pounds, or 7.6 percent, greater in 1980 than in 1975 (table 9). This increase occurred despite changes in relative proportions of the various classes of cattle transferred which would tend to lower the weight in 1980. For example, 16 percent of all cattle transferred in 1975 were cull cows, which are considerably heavier than feeder cattle, compared with less than 10 percent culls in 1980. Further, yearlings accounted for 43 percent of all feeder cattle transferred in 1975 compared with 37 percent in 1980.

The increase in total weight transferred reflects increases in average weight for each class of cattle, noted above, and reductions in death loss rates which allowed transfer of more cattle per cow in inventory. ERS survey respondents indicated that calf death losses prior to weaning declined from 5.5 percent of all calves born alive in beef cow-calf herds in 1975 to 4.4 percent in 1980 (1, 2). Data from the two surveys concerning death losses of older cattle are not directly comparable. However, indications are that 1980 loss rates of weaned calves and yearling feeder cattle as well as brood cows and replacement heifers were also lower than in 1975. Average class weights have been improved by greater use of crossbreeding, particularly crosses involving large dairy or exotic breeds; selection within all breeds for herd bulls with rapid growth rates; and more widespread use of growth-stimulating implants or feed additives. Reductions in death loss rates among calves, yearlings, and breeding stock are attributable primarily to improved disease control and more careful inspection and supervision of the smaller herds managed by most cow-calf producers in 1980 compared with 1975 (1, 2).

Table 9 -- Average total weight of cattle sold or placed onfeed by cow-calf producers per cow and replacement heifer, by class of cattle, 1975 and 1980.

Year	Steer calves	Yearling steers	Heifer calves	Yearling heifers	Cull cows	All classes
			Pounds			
1975	111	82	61	40	127	421
1980	114	108	80	74	82	453

Sources: (1,2).

In contrast to reproductive performance, a production aspect in which hog producers apparently matched or exceeded recent gains achieved by cow-calf producers, average rate of gain in the feeder pig production sector was slower in 1980 than in 1975. Feeder pigs were sold at an average weight of 51 pounds and an average age of 59 days in 1975 (17). In 1980, feeder pigs averaged about 5 pounds lighter and 7 days older at time of sale (19). The trend to earlier weaning may account for this reduction in the rate of gain; the earlier pigs are weaned, the greater the shock and the slower the adjustment to feeds other than sow's milk.

Feed Efficiency

Beef cow-calf producers normally rely on grazing as the primary source of nutrition. Accurate measurements of feed nutrients from grazed forages are not generally available. Pasture or range acreage is a poor proxy for feed quantity or quality because of great differences in composition and yields of pasture sods. However, acreage, by general type of pasture, is the only available measure of feeds grazed from privately owned pasture or rangeland. Grazing permits issued by Government agencies, such as the U.S. Bureau of Land Management or the U.S. Forest Service, to regulate grazing on publicly owned rangeland or forestland located primarily in the West, use animal months (AM) or animal unit months (AUM) as proxy measures of grazed feeds. 2/ Mechanically harvested forages, predominantly hay but including some silage, are the principal cow-calf feeds when grazing is unavailable or inadequate. However, limited quantities of grains or other concentrate feeds are sometimes used to supplement energy or protein deficiencies in low-quality grazed or harvested forages.

Smaller quantities per brood cow of all sources of grazing, except rangeland, were used in 1980 than in 1975, according to ERS survey data (table 10). Producers in all regions, except the West, shifted arable pastureland and native pasture and rangeland out of grazing and into cropping uses faster than they eliminated or reduced beef cow herds during the late seventies in response to increasing export demand for grain crops. In the West, by contrast, low rates of precipitation and/or rugged terrain virtually preclude productive uses other

2/ Parts of South Dakota, Nebraska, Colorado, and New Mexico and all of the more westerly States were designated as the West for the 1981 ERS survey. See (2).

than grazing of much of the rangeland. Therefore, allocation of privately owned range acreage per cow increased as beef cow inventories declined.

Data from the ERS surveys, which included relatively few producers who used public grazing, indicated a reduction in the per-cow allocation of public grazing between 1975 and 1980 (table 10). More comprehensive information assembled by the U.S. Forest Service and the U.S. Bureau of Land Management suggests that cow-calf producers in the West reduced aggregate, but not per-cow, grazing of public lands during this period.

Average use of harvested forages was 4 percent less per cow and 9 percent less per hundredweight of cattle transferred from the cow-calf sector in 1980, compared with 1975. The 120-pound-per-cow reduction in harvested forages fed in 1980 was partially offset in quantity (and more than offset in nutritive value) by an increase of 100 pounds of concentrate feeds.

In brief, increased allocations per cow of privately owned rangeland by producers in one region that contained less than one-fifth of the national beef cow inventory caused private rangeland use per cow to be 42 percent greater on average in 1980 than in 1975. Average use per cow of concentrate feeds, which generally represent less than 5 percent of total annual energy supply in the beef cow-calf sector, also increased 40 percent per cow unit between 1975 and 1980. However, average per-cow use of tame pastureland declined by 25 percent, native pastureland declined by 45 percent, and 4 percent less harvested forages were fed per cow in 1980 than in 1975. In addition, total cattle weight transferred from the sector per cow unit was 7 percent greater in 1980. Thus, feed efficiency improved between 1975 and 1980, although the extent of improvement cannot be estimated precisely.

An analysis of ERS survey data indicates essentially no change in feed efficiency in hog production between 1975 and 1980 (19). On the other hand, there was an improvement in feed efficiency in the production of poultry, which also competes with beef for consumer meat expenditures. Producers used about 1 percent less feed per 100 pounds of broilers and 8 percent less feed per 100 pounds of turkeys in 1980 than in 1975 (4).

Labor Efficiency

Estimated average labor efficiency in cow-calf production declined between 1975 and 1980. Total labor use per cow, estimated by producers in the ERS surveys, increased from 16.4 hours in 1975 to 18.2 hours in 1980 (table 11).

The decrease in average labor efficiency is attributable to operations with fewer than 100 cows each. Producers with herds of 500 or more cows reported the same labor use per cow in 1975 and 1980, and those with herds of 100 to 500 cows estimated that their labor use per cow was lower in 1980. Most of the small herds (containing fewer than 100 cows) are supplemental enterprises on farms whose operators emphasize production of crops and/or other livestock commodities. Labor devoted to the cow-calf enterprise is thus usually intermingled with work in other, more important enterprises and, as a consequence, is rather imprecisely identified, recorded, or subsequently estimated. The data in table 11 are subject to these deficiencies but represent the most comprehensive information available.

Table 10 -- Average feed use per cow and per hundredweight of cattle transferred from the beef cow-calf sector, 1975 and 1980

Item	Unit	Use per cow		Use per cwt	
		1975	1980	1975	1980
Grazing:					
Tame pasture 1/	Acre	1.30	0.98	0.31	0.22
Native pasture 2/	Acre	.69	.38	.16	.08
Private range 3/	Acre	6.15	8.72	1.46	1.92
Crop residues 4/	Acre	1.07	.61	.25	.13
Public grazing 5/	AM	.84	.26	.20	.06
Harvested forages 6/	Ton	1.41	1.35	.33	.30
Concentrates 7/	Cwt	2.51	3.51	.60	.77

1/ Annual or perennial grasses and/or legumes used for grazing that are established and maintained on arable land by periodic reseeding, fertilization, and/or weed control practices.

2/ Native or escaped (introduced but unintentionally spread) plant species grazed from unimproved or nonintensively managed open or lightly forested pastureland.

3/ Native plant species grazed from large tracts of relatively unmodified, privately owned prairie or forestland, located primarily in the western half of the United States.

4/ Plant materials grazed on land from which any crop (including hay) has been harvested during the production year.

5/ Native plant species grazed on a permit basis from Federal- or State-owned rangeland or forestland. AM = animal month.

6/ Hay plus the hay equivalent weight (one-third of the as-fed weight) of ensiled forages.

7/ Grains and other high energy and protein supplement feeds.

Sources: (1, 2).

Unpaid workers, predominantly farm or ranch operators and members of their families, provided a larger proportion of the total cow-calf labor in 1980 than in 1975 (table 11). In fact, unpaid workers accounted for all of the increase in labor use, as hired labor per cow declined by one-fifth. This development is consistent with the change in herd size distribution. Small herds included a larger proportion of the total beef cow inventory in 1980, and unpaid workers were the overwhelming labor source for small cow-calf enterprises. The increased relative importance of small herds in 1980 also contributed to the overall decline in labor efficiency, because in both 1975 and 1980, operations with fewer than 100 cows used twice as much estimated average labor per cow as did operations with 500 or more cows.

Table 11 -- Average annual labor use per cow in the beef cow-calf sector, by source of labor, 1975 and 1980

Year	Operators and other unpaid workers	Hired workers	Total
		Hours	
1975	12.0	4.4	16.4
1980	14.7	3.5	18.2

Sources: (1, 2).

An inverse relationship between size of enterprise and labor use per unit of production also prevails in the feeder pig production subsector. Average size of feeder pig enterprises and the proportion of pigs produced in quite large operations increased rapidly between 1975 and 1980. As a result, labor efficiency increased by almost 25 percent, as average hours per litter declined from 22.4 hours in 1975 to 17.1 in 1980 (17, 19). The improvement in labor efficiency in poultry production was even greater. Output of poultry per hour of labor was 50 percent greater in 1980 than in 1975 (4).

The cow-calf sector will continue to lag other livestock sectors in labor efficiency unless, and until, there is a radical change in production technology that effectively overcomes the current dependence on pastures or ranges as the primary feed source. Most of the land best suited for grazing in humid regions of the Nation is included in relatively small, scattered parcels, which prevent concentration of production. In the traditional range country where large contiguous areas of grazing land are available, scarcity of precipitation constrains forage production, limiting the extent to which cattle can be concentrated. Supervision and care of any type of livestock is more time consuming if the animals are widely dispersed than if they are concentrated in small enclosures, such as modern poultry or hog houses or even dry lots of the type used for cattle feeding. Experimental operations that confine beef cows in small lots and feed them mechanically harvested and transported forages have not proven economically competitive, and no known technology will change this situation soon.

Even if confinement production should become operationally feasible, the resulting improvement (if any) in labor efficiency in the beef cow-calf sector would probably be much smaller than is available in other livestock production sectors. In the production of poultry, hogs, or fed cattle, feeds must be delivered to the animals continuously or regularly throughout the production period. Much of the labor savings from high density, confined production results from the reduction in distances and obstacles over which feed is delivered.

In cow-calf production, by contrast, cattle travel to, and obtain all or most of, their own feeds with minimal labor during grazing seasons; such seasons typically last from 4 months to all year, depending on locational and climatic conditions. Thus, to provide any gain in labor efficiency, time saved in routine care and inspection of cattle in confinement would have to exceed the

additional time needed to collect and deliver large additional quantities of feed.

Labor efficiency is not the only, or even the most important, productivity measure that would change with a trend to confinement production in the cow-calf sector. For example, additional machinery and equipment needed to harvest and distribute feeds and dispose of accummulations of waste materials would represent a large increase in nonland capital use per cow or per unit of output, hence a reduction in capital efficiency. By contrast, efficiency of land use should increase, even if pasture and range forages remained the principal feed sources, because mechanical harvesting would reduce forage losses caused by untimely or selective grazing. Thus, as with most significant changes in production technology, some universally applicable unit of measurement (a common denominator) would be needed to evaluate these different, partially offsetting impacts on overall production efficiency. A monetary unit, the dollar, is frequently used (by design or default) for this purpose.

As summarized by Marion and Handy, "Partial productivity measures indicate the economies achieved over time in the requirement or use of a certain input. They do not indicate changes in the efficiency of using an input since a change in partial productivity ratios may result from factor substitution . . . . Productivity measures that focus on physical or technological efficiency frequently use factor or product price data . . . as a common denominator that allows combining different factors" (5).

ECONOMIC MEASURES

"In economic efficiency, which adds the dimensions of scarcity and utility to physical production relationships by introducing factor and product prices, the concern is with maximizing consumer satisfaction at the lowest cost of factor inputs. Thus, an adequate range of choice and effectively competitive markets are necessary so that relative prices of products and the services approach their marginal costs. Studies have been made of the economic efficiency of certain industries, such as agriculture, using market prices as a surrogate for consumer satisfaction. Such studies thus serve both as enterprise profitability studies, and from a societal view point, studies of economic efficiency" (5).

Competitive Market Features

Economic theory indicates that observed prices are an adequate reflection of consumer satisfaction only in competitive market sectors. Four structural features characterize a purely competitive market: (1) many firms -- a large number of sellers and buyers of the sector output, each of which represents so small a proportion of total sector output that the firm's addition to, or deletion from, the market has no effect on market price; (2) homogeneous product -- the production by all firms in the sector of products that are considered by all potential buyers to be identical; (3) freedom of entry and exit -- the absence of barriers that would prevent or complicate anyone with normal funds and inclination from starting or buying an operating unit or that would restrict sale of an operating unit to any willing and financially able buyer; and (4) independence in decisionmaking -- the absence of collusion among sector participants.

Few, if any, sectors of the U.S. economy perfectly exemplify all characteristics of pure competition. Some, however, approach these standards closely enough to be classified "effectively" or "workably" competitive, in which case they may be evaluated by the norms of pure competition. The beef cow-calf sector is a case in point.

Number and Size of Firms

Although the number of U.S. farms and ranches with beef cows declined about 6.5 percent between 1974 and 1982, cow-calf enterprises remain among the most frequently reported type of farm production activity. In 1982, one or more beef cows were reported on more than 957,000 farms and ranches, almost 43 percent of the total (table 12). Thus, the "many firms" standard of pure competition appears to be adequately met.

Most cow-calf enterprises are also quite small, as might be expected given the large number of producers. In 1982, the average size herd contained only 36 cows and heifers that had calved (table 13). More than 90 percent of all producers had fewer than 100 cows each in the agricultural census years of 1974, 1978, and 1982. Only about 1/2 of 1 percent of all producers have operations consisting of 500 or more cows, although they account for about 14 percent of the total inventory. A few ranchers have herds of 10,000 or more cows each. It is conceivable that such producers might exert some minor influence on feeder cattle prices in some localized areas. It is highly unlikely, however, that the actions of any single producer could significantly affect national average feeder cattle prices, as none accounts for more than a fraction of 1 percent of the national supply.

Product Homogeneity

Products of the beef cow-calf sector include male (either bull or steer) and female (heifer) calves and/or yearlings as well as surplus mature breeding stock (cows and bulls). Cattle in each of these broad age and sex classifications are often sorted (graded) and usually priced on the basis of liveweight and estimates of one or more of the following variable attributes: relationship of muscle to bone and fat, skeletal size or liveweight at maturity or at the end of

Table 12 -- Number and proportion of farms and ranches with beef cows in the United States, 1974-82

Year	Total farms	Farms with beef cows	
	Number	Number	Percent
1974	2,314,013	1,024,935	44.3
1978	2,257,775	1,032,952	45.8
1982 1/	2,241,124	957,693	42.7

1/ Preliminary data.

Source: (16).

Table 13 -- Average size and distribution of beef cow enterprises and distribution of U.S. farms and ranches with beef cows, by size of enterprise, 1974-82

Year	Enterprise size (number beef cows per operation)					
	Average	1-19	20-99	100-199	200-499	500 or more
	Number	Percent				
Beef cows:						
1974	40	11.1	43.6	16.6	15.1	13.6
1978	34	14.2	41.3	15.6	15.2	13.7
1982 1/	36	13.1	40.4	16.2	16.0	14.3
Farms & ranches:						
1974	--	48.9	43.3	5.1	2.2	.5
1978	--	58.3	35.3	4.1	1.9	.4
1982 1/	--	57.1	35.9	4.4	2.0	.6

-- = Not applicable.
1/ Preliminary data.

Source: (16).

a projected feeding period, general health condition including the probability of pregnancy among heifers and cows, the presence or absence of horns, and breed type. The perceived value of cattle sorted on these attributes may still vary significantly depending on the feeding or management regime and the climatic or ecological conditions from which they originate in comparison with their intended destination. For example, feeder cattle from the deep South are thought by some to experience abnormal stress and hence to gain weight relatively inefficiently in the limited space and harsh weather conditions of Northern Plains feedlots. Similarly, cattle raised in arid western areas are thought to perform poorly, at least initially, in humid climates.

In brief, lack of product homogeneity is one reason for elements of regional orientation that persist in the beef cow-calf sector.

Freedom of Sector Entry or Exit

Other than zoning restrictions which prohibit or restrict the maintenance of livestock in designated residential areas, few regulatory or other artificial barriers to entry into or exit from the beef cow-calf sector exist. Federal or State regulations designed to prevent the introduction or spread of some communicable diseases prohibit or specify restrictive conditions under which cattle from some origins may be imported or moved across State lines. However, existing or potential breeding stock of the more common breed types are available in every State. Laws in most States requiring livestock fencing may be considered a form of entry barrier, but, even without such laws, most cow-calf producers would probably choose to use fencing to minimize livestock losses and litigation costs associated with straying, highway collision, or property damage.

Existing and potential land-use restrictions designed to promote soil conservation or "greenbelt" preservation tend to encourage untilled or nonintensively tilled acreage in relatively dense, close-growing vegetative cover. Beef cow-calf production usually flourishes under these environmental conditions. Potential regulations to reduce air or nonpoint water pollution also appear less restrictive to cow-calf production than to many other agricultural uses, because of the relatively large land area normally used per cow.

Decisionmaking Independence

Cow-calf production, especially cattle ranching, is frequently cited as an occupation that epitomizes entrepreneurial independence. The large number and small size of production units serve to prevent effective collusion or even horizontal coordination among decisionmakers controlling appreciable shares of total sector output. The diversity of ecological and agronomic conditions under which participants in the sector operate also serves this purpose. The prevalence of vertical integration or nonmarket coordination is also relatively low in cow-calf production. Most cow-calf producers grow all or much of the harvested forages that they use during nongrazing periods. Some also feed their own calves to slaughter weights in their own or custom feedlots or produce cattle under contract for stocker enterprise or feedlot operators. A vast majority, however, make all production and marketing decisions independently and rely on the open market to purchase their nonforage inputs and to value their production.

In summary, the beef cow-calf sector is characterized by all conditions associated with a unified purely competitive market except product homogeneity. Product variability tends to segment the overall market according to intended end use and, to a lesser extent, geographical components. At most, however, this largely unintentional product differentiation appears only to narrow the scope of competitive market functions and operation. In general, therefore, the market dimensions, hence the performance norms, of the purely competitive economic model apply to the beef cow-calf sector.

Average Costs and Returns

Relationships between average unit production costs and returns are relevant indicators of performance for all types of market systems. When a system approaches pure competition, in which that market prices reflect unconstrained economic preferences of consumers, net returns are a direct indicator of allocative efficiency in the sector. At equilibrium, marginal and average unit production costs in the sector are equal to marginal and average unit revenue, or market price of the product(s).

That is, consumer competition forces product price(s) to level(s) that permit efficient producers to earn only normal profits for their entrepreneurial talents after paying market prices for the minimum quantities of resources required for that level of output. Any greater output would cause a decline in product prices and consequent negative net returns to producers in the sector with higher than average unit production costs. Any smaller output would similarly cause consumers to bid up prices enough to attract the most economically efficient potential producers into the sector.

Several features of the beef cow-calf production sector tend to complicate or obscure real-world functioning of this theoretical adjustment process. Length of the production period in combination with the output adjustment process is an

example. Producers of feeder calves normally experience a lag of at least 18 months between the time the production process starts, with a decision as to the number of cows and replacement heifers to be bred, and the sale date of the resulting calves. For producers of yearling feeders, the minimum interval is usually about 24 months (fig. 2). A decision to expand feeder cattle production extends the payoff period by 24 additional months, the gestation and growout time needed to raise expansion heifers to sexual maturity (fig. 2).

Note that a decision to expand feeder cattle output causes an initial reduction in feeder cattle supply (the additional heifers retained as expansion breeding stock that would have been available as feeder animals if no expansion were attempted). Conversely, the extra heifers that are offered as feeder cattle, rather than being retained as breeding herd replacements, when producers attempt to reduce output, cause an additional temporary increase in feeder cattle supply before the eventual decrease.

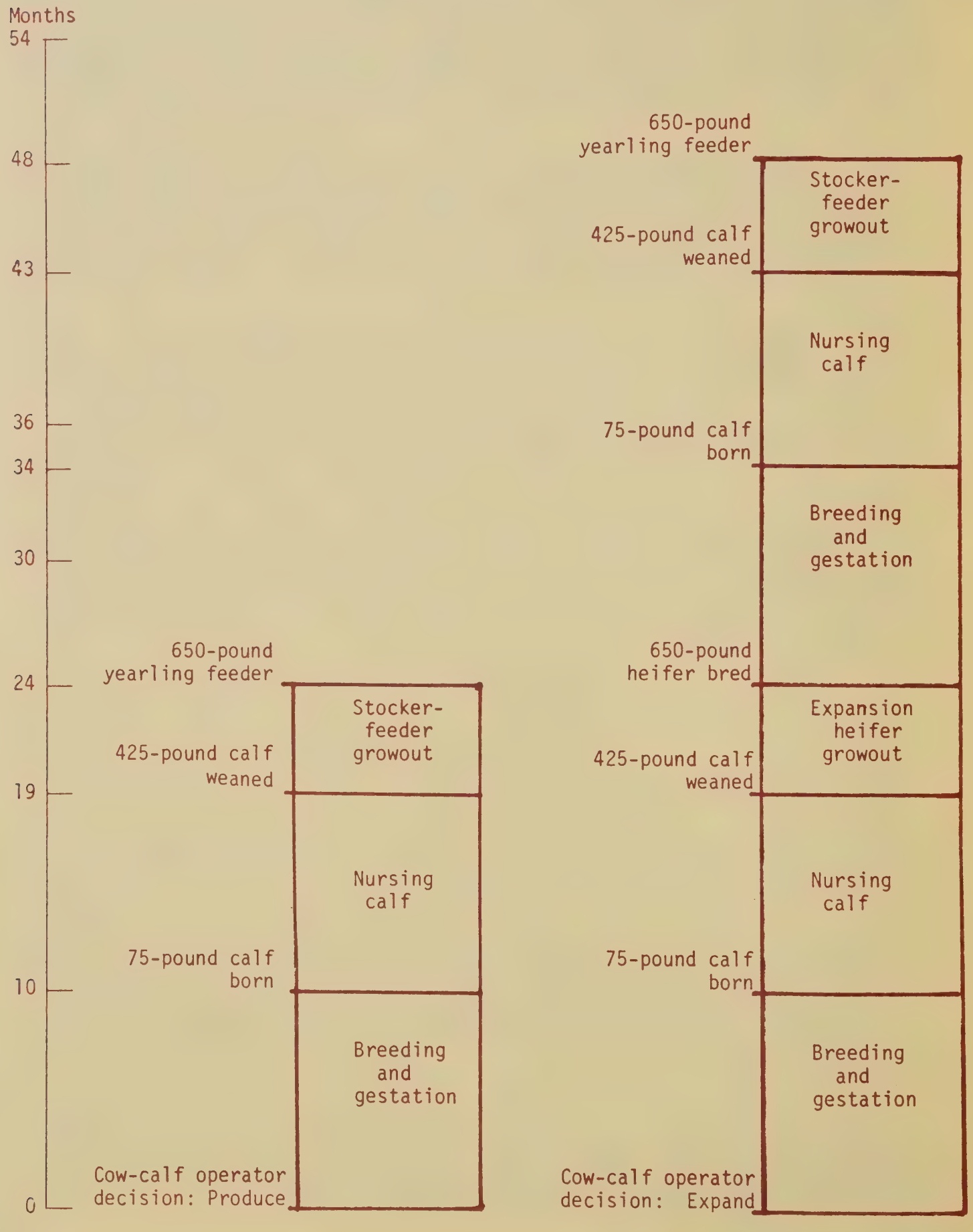
Another complication is that the categories of average cost that must be compared with average revenue in projecting net returns differ, depending on the length of the planning period and the importance of cow-calf production as a source of livelihood to the producer. If an ongoing cow-calf enterprise is supplementary to other economic endeavors of a producer, projected average receipts in comparison with average cash expenses of production defines the net returns on which short-term production planning should be based. A producer who depends on feeder cattle production as a major or only income source needs to recoup the value of unpaid labor (to provide living expenses) and cash production costs (to justify continuation of the enterprise in the short run). And for decisionmaking in the long run, when all resources used in cow-calf production must be acquired or replaced, average total economic costs are the appropriate costs to be compared with projected average receipts in assessing anticipated net returns (table 14). 3/

Annual estimates of average sales receipts and production costs per beef cow during 1976 through 1983 do not indicate any recent improvement in economic performance of the beef cow-calf sector. In 1979, sales receipts of the average producer exceeded cash expenses by more than $100 per cow and fell less than $90 per cow short of covering total economic costs. Economic performance has apparently worsened each year since then (table 14).

Rapid escalation in feeder cattle prices during late 1978 and early 1979 led producers as a group to overproject cattle prices in formulating production plans for the early eighties. Unanticipated periods of recession during 1980 and 1981-82 and record-high interest rates and fuel prices added to the problem by curtailing demand for beef and raising production costs of feedlot operators. Droughts during 1980 and 1983 also contributed to greater feed cost increases in both the cow-calf and the cattle feedlot sectors than might have been anticipated in production planning. Thus, lack of knowledge of forthcoming setbacks in both the agricultural and general economy, rather than lack of competitive forces in the cow-calf sector, probably account for recent declines in economic performance in the sector.

3/ Total economic costs include cash expenses plus: (1) an annual sum adequate to accumulate over time into a fund large enough to allow necessary periodic replacement of depreciable assets, and (2) opportunity returns to unpaid labor and to capital invested in depreciable assets and land.

Figure 2. Typical beef cow-calf production schedule



Source: (2).

Table 14 -- Estimated revenue and costs per cow in the U.S. beef cow-calf sector, 1976-83

Item	1976	1977	1978	1979	1980	1981	1982	1983
				Dollars				
Receipts	134.73	146.91	233.23	315.46	306.91	260.64	255.49	247.18
Cash expenses:								
Feed	59.06	84.30	80.42	89.88	102.70	114.28	113.94	114.33
Hired labor	7.62	7.92	8.53	9.43	11.72	13.41	13.02	13.49
Other variable expenses	23.53	27.14	29.32	36.41	47.51	52.60	54.47	54.07
Total variable cash	90.21	119.36	118.27	135.72	161.93	180.29	181.43	181.89
General farm overhead	6.75	7.89	8.36	9.49	10.29	11.84	13.01	13.43
Taxes and insurance	16.09	15.27	16.15	19.82	20.52	19.62	20.87	22.23
Interest expenses	16.75	17.28	28.13	43.01	39.31	43.91	46.75	42.60
Total fixed cash	39.59	40.44	52.64	72.32	70.12	75.37	80.63	78.26
Total cash expenses	129.80	159.80	170.91	208.04	232.05	255.66	262.06	260.15
Receipts less cash expenses	4.93	-12.89	62.32	107.42	74.86	4.98	-6.57	-12.97
Economic costs:								
Cash expenses less cash interest	113.05	142.52	142.78	165.03	192.74	211.75	215.31	217.55
Capital replacement	18.90	34.59	37.39	46.74	54.19	59.22	62.88	65.38
Allocated returns to--								
Operating capital	3.11	3.75	5.24	7.34	11.71	15.86	12.61	10.05
Other nonland capital	14.99	27.44	29.66	37.07	49.73	47.72	46.08	46.83
Land	71.44	84.05	92.03	105.54	127.07	136.94	142.61	134.22
Unpaid labor	28.37	37.42	40.28	42.44	65.29	72.11	71.71	74.72
Total economic costs	249.86	329.77	347.38	404.16	500.73	543.60	551.20	548.75
Receipts less economic costs	-115.13	-182.86	-114.15	-88.70	-193.82	-282.96	-295.71	-301.57
Receipts less cash expenses and unpaid labor	-23.44	-50.31	22.04	64.98	9.57	-67.13	-78.28	-87.69

Sources: (3, 7, 8, 9, 11, 12).

Average Costs and Enterprise Size

The cost and returns information discussed above is based on average data for the entire beef cow-calf sector. Such average data indicate performance of the sector as a whole, but mask production cost differences within the sector associated with size of enterprise.

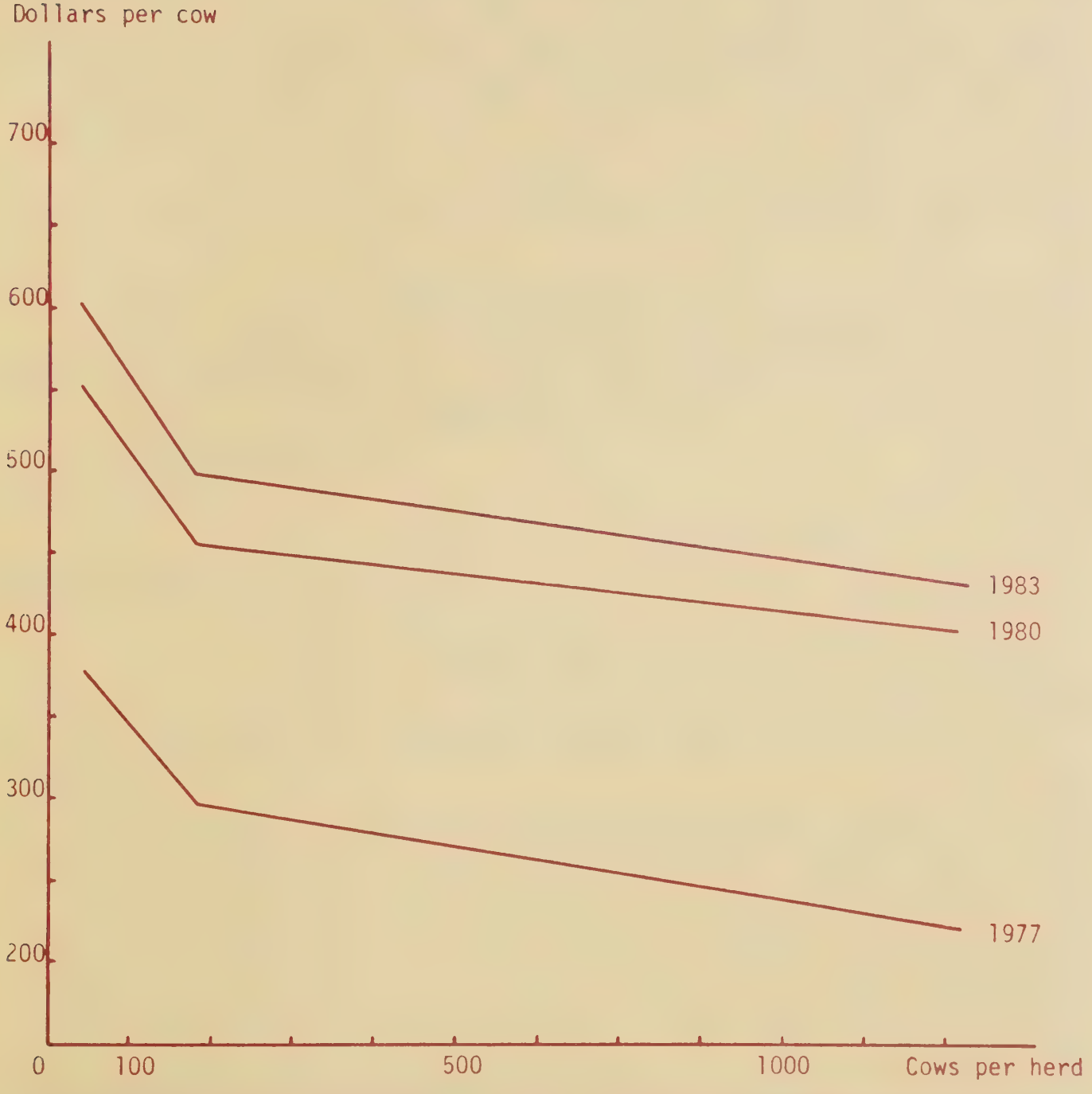
Economic theory (and simple logic) indicates that producers maximize profits by adjusting the quantities of inputs that can be varied during a specified planning period to equate marginal cost with marginal revenue, which is equal to product price in a competitive market. As the planning period becomes longer, an increasing share of all inputs used in production becomes variable. For analytical convenience, the time required to change size of an enterprise may be used to distinguish between shortrun and longrun planning periods. For a cow-calf producer, a period of 4 years or less is adequate to change size of enterprise significantly (fig. 2).

In most industries, average total production costs vary with size of enterprise. An analytical concept termed a longrun average cost curve is frequently used to illustrate the relationship between average production cost and size of operation. A longrun average cost curve is a curve joining minimum average costs of producing each possible level of output when all resources, including those that determine size of enterprise, are optimally organized for each output level. The portion of a longrun cost curve that declines as output per unit of time increases depicts increasing returns to size, or economies of size, contrasted with diseconomies of size in the portion of the curve that rises with level of output and size of enterprise.

Economic theory indicates that in a purely competitive market sector, only producers with enterprises of the size(s) that yield minimum average total costs will persist in the long run. Enterprises of nonoptimal sizes may exist because of faulty information used by producers in organizing existing enterprises or changes in product or input prices that occurred after such enterprises were organized. With no barriers to sector entry or exit and with all inputs perfectly homogeneous in characteristics and price, product demand in a competitive sector will force producers with enterprises of nonoptimal size to adjust to the minimum cost size or sustain permanent economic losses. Such economic losses vary directly with economies (or diseconomies) of size in the sector and with the extent to which the enterprise deviates from the minimum-cost size. Thus, during any relevant period, the rate of adjustment toward optimum enterprise size should be faster among operations that differ most from optimum size.

The dispersion in size of enterprises in the beef cow-calf sector is well documented by Census of Agriculture data. Considerable evidence indicates that substantial economies of size exist in the sector. Average total economic costs per cow in enterprises of fewer than 100 cows each were 64 percent greater than in operations with more than 500 cows in 1977 and remained 37 percent greater in 1983 (fig. 3). Variations by size of enterprise in average sales receipts per cow actually added to the economic advantage of larger sized enterprises in 1977 and did little to offset the advantage in 1983. Total economic costs per dollar of cattle sales receipts were 68 percent greater in herds of fewer than 100 cows than in operations with more than 500 cows in 1977 and were 34 percent greater in 1983. Cash expenses per dollar of sales receipts were also consistently greater in smaller cow-calf enterprises during this period (fig. 4). Yet, no recent proportional increases are indicated in the number of larger, lower cost

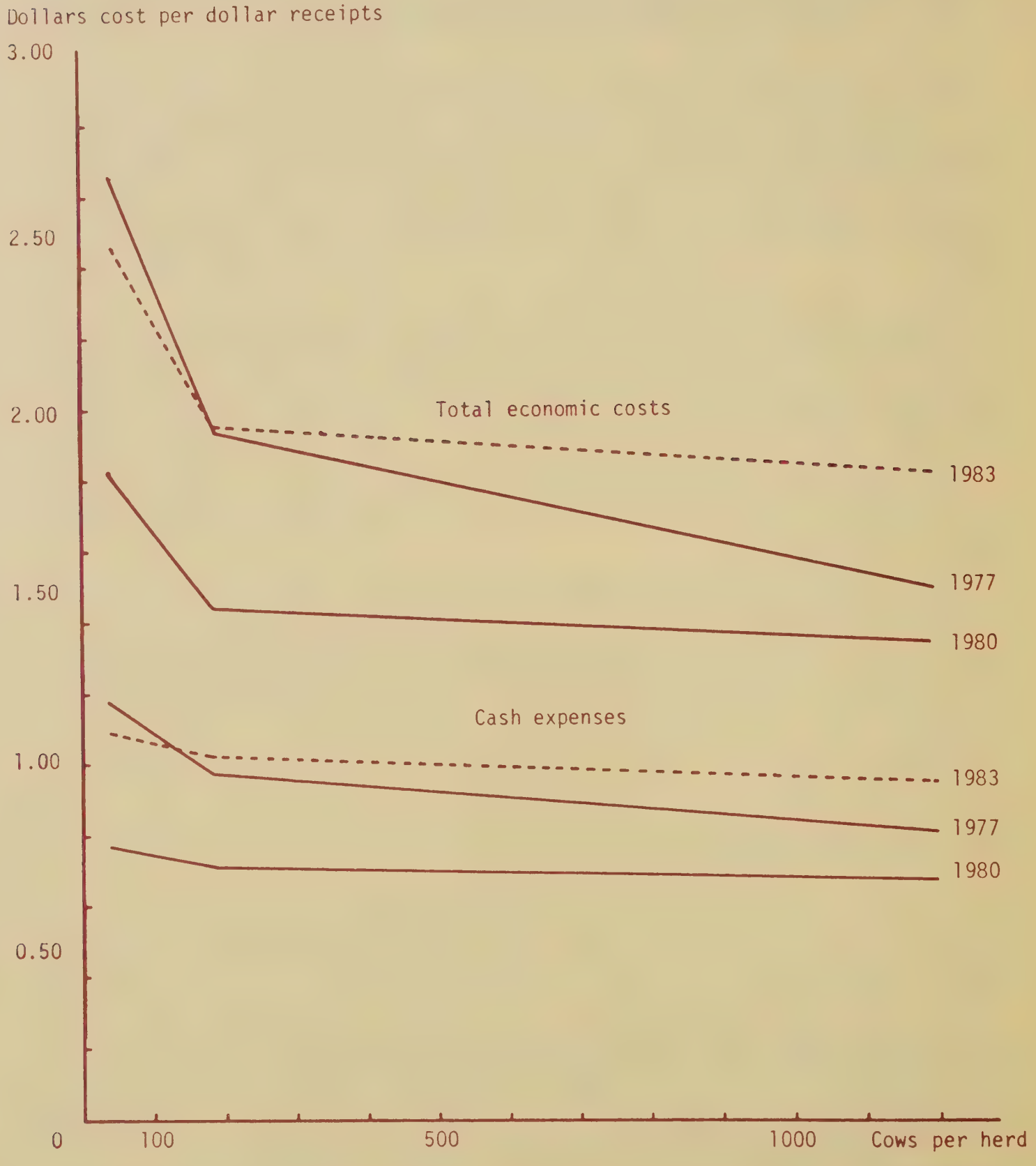
Figure 3. Relationship between beef cow-calf enterprise size and average total economic costs per cow, selected years 1/



1/ Enterprise size groupings and cost estimating procedures for 1977 adjusted to those used in 1980 and 1983.

Sources: (9, 11, 12).

Figure 4. Relationships between beef cow-calf enterprise size and average economic costs and cash expenses per dollar of cattle sales receipts, selected years 1/



1/ Enterprise size groupings and cost estimating procedures for 1977 adjusted to those used in 1980 and 1983.

Sources: (9, 11, 12).

enterprises in the U.S. beef cow-calf sector, hence no evidence of change in this indicator of economic efficiency exists (table 13).

Figure 3 depicts relationships between enterprise size and average total economic costs per cow in the beef cow-calf sector of the entire Nation. Economies of size are considerably greater in the South and West regions than the national average. In 1983, for example, costs per cow in herds of fewer than 100 cows exceeded those in enterprises of more than 500 cows by about 47 percent in each of these regions, compared with 37 percent nationally. By contrast, costs per cow in small herds in the Great Plains were only 7 percent greater than in large herds. And in the North Central region, per-cow costs were 2 percent lower in small cow-calf enterprises than in large enterprises; that is, minor diseconomies of size were indicated. Intermediate-sized operations, with 100 to 499 cows each, achieved the lowest average total economic costs per cow in both the Great Plains and North Central regions, while costs were lowest in large enterprises in the South and West. 4/

A major reason for such regional differences is the lack of homogeneity and mobility of some resources used in the beef cow-calf sector. Grazing land is a prime example.

Acquiring control of, and managing, enough grazing land to support a large cow-calf enterprise is normally easier and relatively less costly in areas where grazing is a predominant land use than in areas where land best suited for grazing is confined to small tracts widely interspersed among cropland. The proportion of grazing land is greatest in range areas of the West and the Gulf Coast portion of the South, and least in the central Corn Belt portion of the North Central region.

Regional Costs and Returns

Although many factors influence the location of economic activity, the profit motive is normally considered the strongest force in a free market society. As summarized by Williams, "Production of a particular commodity will tend to concentrate in those areas where net returns are highest relative to such returns that might be earned through alternative employment of the available factors . . . . Producers . . . do not necessarily seek to minimize costs in considering new locations, as often is assumed, they seek to maximize profits. Again, regional differences in demand, as well as costs, must be considered" (24).

Regional differences in demand may arise from differences in population, the level and distribution of income, or the distribution of consumer preferences. However, if there are no nonmarket trade barriers, interregional trade in the product would tend to eliminate rather rapidly any regional product price differences attributable to these demand factors. By contrast, differences among regions in real or perceived quality of products may cause persistent differences in regional average product prices. By definition, product quality differences do not exist in a purely competitive market sector, but may be rather common in sectors considered effectively competitive. If economic forces lead to interregional trade, regional product prices tend to differ over time by the amount of unit transfer costs, even in a purely competitive sector. Unit

4/ Derived from unpublished aggregated summaries of Farm Enterprise Data System cost-of-production budgets for beef cow-calf enterprises in 1983.

transfer costs include average transportation costs plus or minus any regional differences in average costs of procurement and assembly per net unit of product.

Factors that are usually individually or jointly responsible for differences in average production costs at any point in time in an effectively competitive market sector are regional differences in: (1) supply of, compared with derived demand for, inputs needed for production, or relative scarcity of factors; (2) physical productivity due to technical input-output relationships; (3) level or distribution of enterprise organizational characteristics, such as production specialization and enterprise size; and (4) input prices.

Given a sufficiently long adjustment period, interregional trade in inputs and/or products would serve to eliminate regional differences in relative scarcity and prices of mobile inputs, and transfer of information or skills would minimize production cost differences attributable to technical and organizational differences. But, a rather long period may be required for sufficient interregional transfer of investment in capital facilities or organizational talents. Further, grazing land, of course, is immobile. As a result, Williams noted, "Net returns tend to be highest in production of a commodity . . . near the source of the least mobile resources necessary for production. Accordingly, cow-calf production has tended to locate in areas of the West and Southwest where abundant but immobile grass resources result in net returns that are high relative to potential net returns from alternative uses of land and other farm production resources . . . . Improved substitution possibilities among factors modify the locational demands imposed by resource immobility" (24).

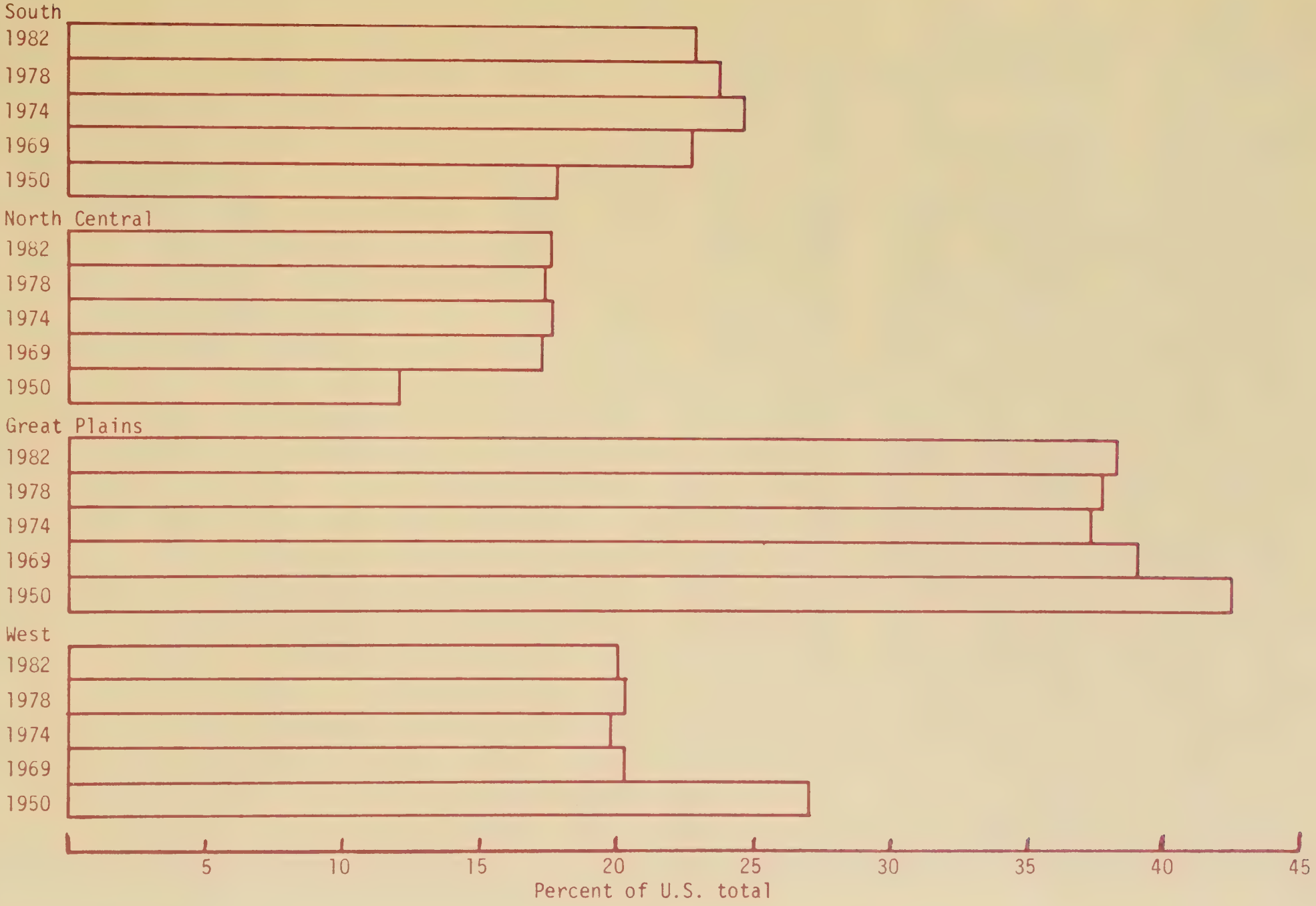
The demand for grain-fed beef, hence feeder cattle, started to increase rapidly in the fifties (20). In response to this surge in demand, the national inventory of beef cows increased by more than 150 percent, rising from 16.1 million to 41.2 million head, between 1950 and 1974 (16). The regional distribution of cow-calf production also changed significantly during this period. Producers in the South and North Central regions increased their proportions of the national inventory by 6.8 and 5.4 percentage points, respectively, compared with declines of 5.2 and 7.2 percentage points in the Great Plains and West (fig. 5).

Shifts in relative demand account for the large increase in beef cow-calf production in the North Central region. Milk cow numbers were decreased by slightly more than the increase in beef cows between 1950 and 1970. Regional pasture acreage actually declined during this period (21).

In the South, by contrast, reductions in milk cows supplied only about one-third of the grazing resources used to expand beef cow-calf production. Resource substitution accounted for much of the remainder. Fescue, Coastal bermudagrass, and other improved pasture species that produce relatively high yields and quality of forage when fertilized heavily, especially with nitrogen, were substituted for lower yielding species. In effect, nitrogen, which was relatively cheap until the seventies, was substituted for land, the value of which was supported by profit potential from crop or timber production (21).

Nitrogen prices more than doubled, however, between 1973 and 1974, because of a shortage of natural gas used to manufacture most nitrogen fertilizers. This development caused increases in the costs of grazing and harvested forages that were considerably greater in the South than in other cow-calf production regions.

Figure 5. Regional distribution of beef cows, selected years, 1950-82



Source: (10).

This regional disadvantage in cow-calf production costs has continued as fertilizer prices have trended upward. In 1977, the first year for which ERS provided comprehensive estimates of regional cow-calf production costs, feed costs per hundredweight of cattle sold were about $4 higher, and total cash expenses averaged $5.90 higher, in the South than in any other region. By 1983, when nitrogen fertilizer prices were almost three times their 1973 levels, feed costs and total cash expenses in the South were higher than in any other region by nearly $11 and $15 per hundredweight, respectively (table 15).

Furthermore, prices received for feeder cattle are generally lowest in the South, primarily because of the relatively high costs of assembling truckload lots of uniform cattle from the small cow-calf enterprises that predominate in the South and transporting the cattle to major feeding areas in the Plains States. (Average receipts per hundredweight were lower in the West in 1983 because demand for yearling feeders was lowest during the late summer and early fall months, the peak sale period for western yearlings. Yearlings represent about twice as great a proportion of total feeder cattle sales in the West as in the South.) Thus, net returns were consistently lowest during 1977-83 in the South, regardless of the length of planning period (table 15).

Beef cow numbers declined faster in the South than in any other major production region from 1974 to 1982. Producers in the South accounted for 24.6 percent of the national beef cow inventory in 1974, 23.6 percent in 1978, and only 22.7 percent in 1982 (fig. 5). These data appear to indicate some, though very slow, improvement in the regional allocation of resources to the beef cow-calf sector. Cost and returns estimates indicate quite clearly, however, that too many resources are still allocated to the sector as a whole and that the surplus remains greatest in the South (table 15).

Table 15 -- Estimated receipts and costs per hundredweight of cattle sold in the beef cow-calf sector, by regions, 1977 and 1983 1/

Item	1977				1983			
	South	North Central	Great Plains	West	South	North Central	Great Plains	West
	Dollars							
Receipts	33.63	36.25	35.50	35.06	53.22	56.73	55.59	52.68
Cash expenses:								
Feed	25.23	18.99	14.97	21.28	34.68	21.43	23.95	21.56
Hired labor	2.37	.61	1.94	2.12	3.69	.76	2.61	4.53
Other	7.66	7.56	5.92	4.25	14.81	11.54	11.68	10.07
Total variable cash	35.26	27.16	22.83	27.65	53.18	33.73	38.24	36.16
General farm overhead	2.20	2.00	1.67	1.80	2.99	3.22	3.12	2.51
Taxes and insurance	3.03	5.12	3.05	4.61	4.96	9.06	4.00	3.29
Interest expenses	3.96	4.27	4.18	4.12	8.76	9.10	9.85	9.54
Total fixed cash	9.19	11.39	8.90	10.53	16.71	21.38	16.97	15.34
Total cash expenses	44.45	38.55	31.73	38.18	69.89	55.11	55.21	51.50
Receipts less cash expenses	-10.82	-2.30	3.77	-3.12	-16.67	1.62	.38	1.18
Economic costs:								
Cash expenses less cash interest	40.49	34.28	27.55	34.06	61.13	46.01	45.36	41.96
Capital replacement	9.92	12.20	6.80	6.19	19.25	15.54	13.12	11.29
Allocated returns to--								
Operating capital	1.37	1.22	.49	.80	3.18	2.15	1.69	2.23
Other nonland capital	7.70	9.30	5.61	5.20	12.92	11.09	9.63	8.65
Land	23.40	26.90	16.73	13.38	39.47	38.19	28.26	16.70
Unpaid labor	12.21	13.73	7.30	5.75	17.25	21.04	14.77	15.20
Total economic costs	95.09	97.63	64.48	65.38	153.20	134.02	112.83	96.03
Receipts less economic costs	-61.46	-61.38	-28.98	-30.32	-99.98	-77.29	-57.24	-43.35

1/ Regions and cost estimating procedures for 1977 are adjusted to match those used in 1983. The Great Plains estimates for 1977 are the weighted averages of data for regions termed the Great Plains and the Southwest for the 1976 ERS survey.

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